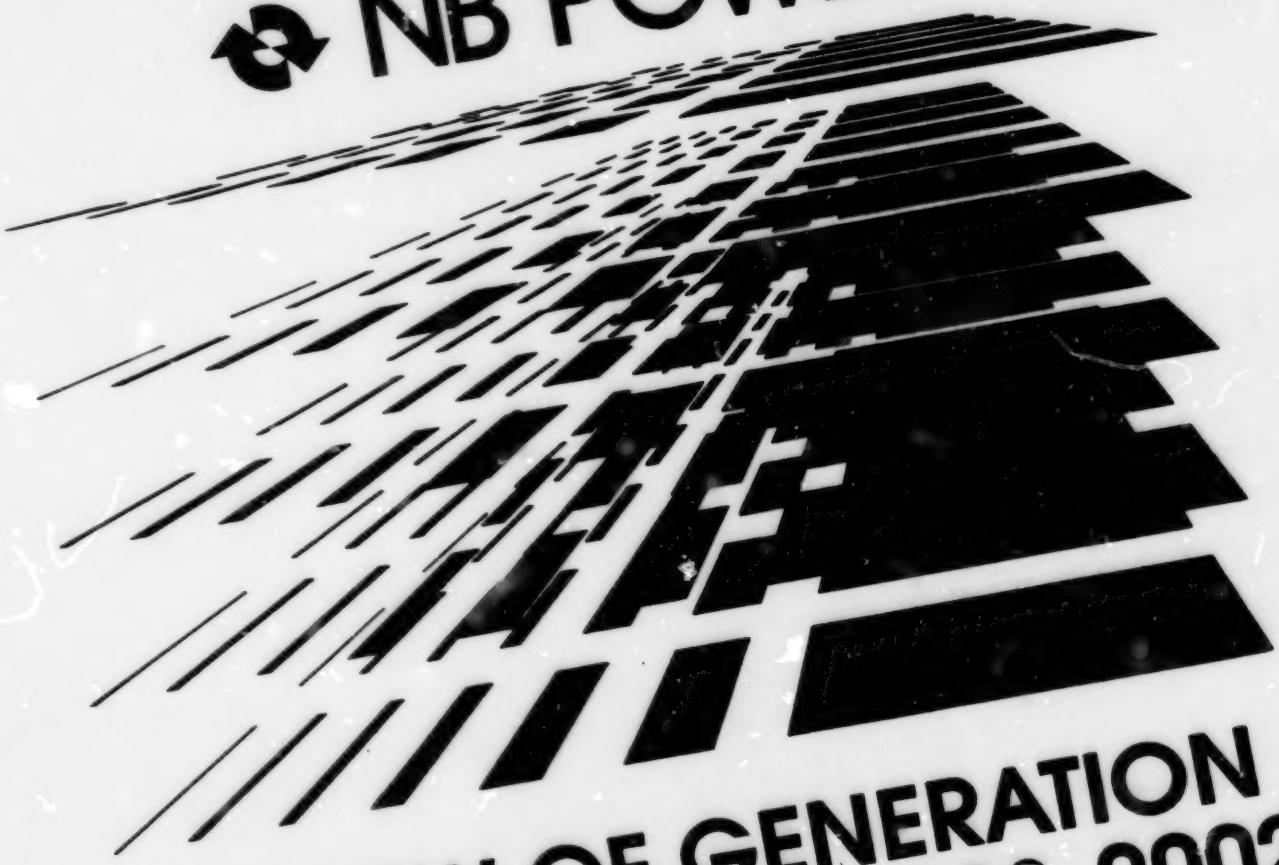
R1ID 3520

NB POWER



REVIEW OF GENERATION REQUIREMENTS 1988-2002

91-04480/

REVIEW OF GENERATION REQUIREMENTS

1988 - 2002

JANUARY 11, 1989

REVIEW OF GENERATION REQUIREMENTS
1988 - 2002

CONTENTS

		PAGE
I.	SUMMARY	1
II.	GENERAL OBJECTIVES	4
III.	BACKGROUND	7
IV.	DEVELOPMENT OPTIONS	15
V.	GENERATION DEVELOPMENT PLAN	32

I. SUMMARY AND CONCLUSIONS

INTRODUCTION

NB Power is embarking on another phase in its generation development with the initiation of processes for the construction of a 450 MW coal unit at Belledune. The unit is scheduled to be in service in 1993.

This document has been prepared in response to guidelines issued by the Department of Municipal Affairs and Environment (DMAE) for the Environmental Impact Assessment of the project. It summarizes the various generation planning activities which have been completed during the past five years since the completion of Point Lepreau 1 in 1983 and describes how the 450 MW coal unit will fit into the overall development of the NB Power generating system.

PLANNING CHRONOLOGY

Power generation projects take many years to plan, design, construct and commission. Consequently, starting in 1985, NB Power initiated a concerted effort to determine an economic and reliable means for meeting the growing electricity needs of the province. The projected need for new energy sources in the mid 1990's meant that environmental and engineering work would have to begin in the late 1980's.

In late 1985 and early 1986, it was determined that, if a cost based market could be found for a portion of the unit, then the construction of a large coal unit (500 MW) could be an economic generation addition for the early 1990's. Designs were initiated and cost estimates prepared for a 500 MW coal unit from which up to 1/2 the capacity would be sold to external markets. Offers were made to neighboring New England utilities, but due to the uncertainty of their overall demand/supply situation, NB Power was unable to reach an agreement on the sale.

In early 1987, after three consecutive years of high in-province load growth experience, NB Power revieved possibilities for a scaled-down project which it could undertake on its own in a shorter time frame for completion by 1991. It was at that time that a 200 MW coal unit was proposed. The unit would be located at Grand Lake, the site of an existing plant and would burn the high sulphur coal mined in the area that is presently shipped by rail to Dalhousie.

Another alternative that was pursued in parallel with the Grand Lake unit was a purchase from Hydro-Québec which would meet the 1991 requirement and provide a more economic source of supply for the period.

In November 1987, a letter of intent was signed between NB Power and Hydro-Québec for the purchase of firm energy and capacity from 1988 to 1994. The contract, which was finalized in March, 1988, meant that NB Power could defer the need for added generation, thereby providing an achievable time frame for generation additions to come into service at the conclusion of the Hydro-Québec contract.

Preliminary engineering and design immediately commenced for a 400 MW coal unit with a targeted in-service date of 1993. This unit, later increased in size to 450 MW as a result of the proposals received in the tendering process, is the subject of this report.

450 MW COAL FUELLED UNIT

The proposed unit was found to be the economic choice of all the options studied for new generation. It is proposed, pending required approvals, to be built at a site at Belledune on the Bay of Chaleur, thereby assuring year round marine access to world coal supplies. Low sulphur coal, the planned fuel for the unit, is readily available from several sources around the world at competitive prices.

The unit will provide needed additional capacity and will also contribute to the reduction of NB Power's current dependency on imported heavy fuel oil which has historically been shown to be subject to wide cost swings.

Rationale for the siting of this unit, the Environmental Impact Assessment for the plant and its role in NB Power's SO_2 reduction program are all described in related documents.

GENERATION DEVELOPMENT PLAN

The 450 MW coal unit fits into a generation development program which maintains flexibility for future generation choices while satisfying the prime objectives of NB Power's development strategy. It will result in a **Secure Supply** of power at **Competitive Cost** with an **Acceptable Financial Risk** and will do so with an **Acceptable Environmental Impact.**

The complete development program to which NB Power is presently committed, consists of:

- Conversion of a unit at Coleson Cove to burn Orimulsion coupled with the installation of flue gas desulphurization equipment on that unit. Environmental and engineering work have been initiated with the objective of a 1991 in service date.

- Installation of a 450 MW coal fired unit at Belledune in 1993 using low sulphur imported coal.

- Installation of a 150/200 MW coal fired unit at Grand Lake, with SO_2 removal capabilities, in 1994.

- Dalhousie unit 2 fuelling changed from indigenous New Brunswick coal to low sulphur imported coal in 1994.

- An additional generation source projected for 1997 or 1998. This could be supplied from a second 450 MW coal fired unit at Belledune or a second nuclear unit at Point Lepreau depending on the economics of alternatives and their commercial in-service dates.

II. GENERAL OBJECTIVES

NB Power is a Crown Corporation created by an Act of Government in 1920. The act gives NB Power the responsibility to generate and transmit electricity within the Province of New Brunswick to meet the needs of the people of New Brunswick. The act more specifically states:

"The intent, purpose and object of this Act is to provide for the continuous supply of energy adequate for the needs and future development of the Province and to promote economy and efficiency in the generation, distribution, supply, sale and use of power."

In the implementation of this mandate, a number of factors must be considered in the selection of future facilities to meet the electrical needs of the Province. They include the short and long-term effect on power costs, security of supply, corporate risks and financing capability. A balancing of these factors must always be considered in selecting new facilities.

Within NB Power's mandate, there are then three primary objectives: A. Competitive Power Costs, B. Security of Supply, and C. Acceptable levels of Financial Risk. NB Power also has the responsibility of achieving these objectives within the requirements of Provincial Environmental Regulations.

A. COMPETITIVE POWER COSTS

One of NB Power's primary objectives is to achieve and maintain power rates which are as low as reasonably practical and as competitive as possible with other parts of Canada. This is a difficult objective in light of New Brunswick's relative lack of hydro, indigenous coal and petroleum resources as compared with many other provinces.

Existing power rates in New Brunswick are the lowest in the Maritimes but are still above the Canadian average. This, combined with the relative importance of power usage in New Brunswick compared with other provinces, places the achievement of competitive power rates as a key consideration in the formulation of a generation development plan.

A comparison by province of the quantity of electrical energy expended in kilovatthours to produce a dollar of gross provincial production places New Brunswick some 30% above the Canadian average and the third highest in Canada. This results, of course, from the preponderance of power-intensive, resource-based industries such as forestry and mining.

Competitive power rates are also relevant to individuals within New Brunswick. NB Power's customers are, in effect, it's owners. NB Power, therefore, strives to keep rates stable as well as low to insulate electricity customers from the uncertainties of future fuel costs, loads, and economic conditions. It is with these factors in mind that a generation plan is formulated.

B. SECURITY OF SUPPLY

NB Power must develop and maintain secure electrical energy supplies to meet New Brunswick's growing requirements. Security of supply has two main facets: security of power plant fuels and the maintenance of adequate capacity reserve. It is always necessary to balance this objective against the primary objective of competitive power costs.

NB Power's in-province electricity supply in 1987-88 was provided as follows:

Nuclear	28%
Hydro	17%
Coal	3%
Imports	28%
Oil	24%

Diversification of generation and fuel types is the strategy used for ensuring security of supply. NB Power's current sources are well diversified; however, declining electricity imports from Québec are leading to increased reliance on oil.

The best way to address the security of fuel supply issue appears to be to make certain that new units have the flexibility to burn alternative fuels and that selected existing units are modified to achieve this dual capability. Furthermore, generating stations should be located with year-round open water access for shipping. New Brunswick, with its relatively large coast line, is ideally suited for this strategy.

Consequently, multi-fuel flexibility is a second key strategy that is followed in generation planning.

Another consideration in terms of security also relates to a utility's ability to rely on support from interconnected utilities in times of supply shortages. NB Power must continue to utilize its strong interconnections to help maintain secure supplies for New Brunswick's needs.

C. FINANCIAL RISK

A third major objective is the maintenance of acceptable levels of financial risk. NB Power is a medium-sized utility operating in a province of some 750,000 people. The financial obligations of the utility business can become large in relation to the financial capabilities of New Brunswick, and this must be considered in development planning.

The larger financial risks generally occur in the areas of heavy capital investments and long-term contractual obligations. The utility's ability to accept such risks may temper its efforts in achieving its other major objectives. Again the level of financial risk must be balanced against the primary objective of competitive power costs.

III. BACKGROUND

A. HISTORICAL DEVELOPMENT

Prior to examining NB Power's present development setting and its' planning to meet the challenges over the next 15 years, it is of interest to review the utility's recent history in light of its three primary objectives: competitive power costs, security of supply and manageable financial risk. The past 15 year period has been one of great upheaval in which many external factors have made achievement of the utility's objectives difficult. Only in the last 3 years of the period would it be fair to say that financing and fuel costs have been at reasonable levels.

NB Power established its major interconnections with Québec, Nova Scotia and New England prior to the last major generation expansion cycle which occurred in the 1972-1982 period. Because of these interconnections, the utility was able to construct large units and thereby achieve economies of scale, with energy surpluses exported over these interconnections under profitable arrangements. Unit participation sales were used as a mechanism to transfer a portion of the costs and financial risks of building large and efficient units to other utilities for an initial period until the NB Power system was large enough to absorb them.

These major generation developments themselves were committed at a time of extremely high load growth averaging 10%/year. Security of supply was a major concern from the standpoint of ability to meet the province's energy demands. The generating stations and their commitment dates were as follows:

Committed	Station	Fuel Type
1972	1000 MW Coleson Cove	Oil
1974	630 MW Point Lepreau	Nuclear
1974	200 MW Dalhousie II	Coal/Oil
1974	200 MW Mactaquac 5 & 6	Hydro

One of the major disruptive factors for NB Power in the period were recurrent oil price shocks. This was, and continues to be, a major problem for many North American utilities which do not have ready access to alternative indigenous resources. The first such shock occurred in 1973 and successive shocks recurred in 1976, 1980, and 1983. Prices rose from (U.S.) $1.60/bbl. in early 1973 to (U.S.) $27.50/bbl. by late 1985, an increase of 18 times. Relief from the damaging prices finally did not come until 1986.

NB Power's development planning since the time of the first oil shock has had an off-oil focus. New generating units committed since that time have all been nuclear, hydro or coal-based. Other steps have been taken more recently to reduce oil usage including the raising of the Mactaquac headpond by three feet in 1985 and the construction of a second 500 MW interconnection with Québec in 1986.

Still, the oil price shocks of the 1973-1985 period were a major impediment for NB Power in achieving its power cost objectives. The direct effects were significantly reduced by the various off-oil developments such as nuclear and the Hydro-Québec ties, but a major indirect effect continued as a growing problem until oil prices finally collapsed in 1986. This indirect effect relates to purchased power from Hydro-Québec which has been priced at 80% of the value of the fuel replaced on the New Brunswick system (predominantly oil). Off-oil conversion planning has been a major focus in recent years to remove both the remaining direct and indirect oil exposures.

The oil shocks were also a major factor in the rampant inflation and double-digit interest rates which plagued North America in the late 1970's and early 1980's. These factors lead to major cost increases in the generation projects built during the period which have had lingering adverse cost implications for NB Power. Only recently has the utility been able to replace the highest cost borrowings from that period with more attractive financing. In the case of Point Lepreau, nuclear regulatory change, particularly as related to the Three Mile Island incident in 1979, compounded the capital cost escalation problem.

Turbulent financial markets were a side-effect of the negative economic climate. This turbulence, superimposed upon a Canadian capital market which was not as fully developed as it is today, forced electric utilities, including NB Power, to rely heavily upon foreign capital markets to finance their development programs. Massive foreign exchange exposures arose for the utilities which soon became a major cost problem as the Canadian dollar entered into a decade-long tailspin. It has only recently rebounded.

NB Power's interconnections were invaluable in meeting these challenges. Costs and financial risks of major portions (35-40%) of the largest new stations, Lepreau and Coleson Cove, were transferred to American utilities through unit participation sales contracts. This helped satisfy the financial risk objectives while permitting access to the economies of scale inherent in large generating stations.

Interconnection benefits from interruptible purchases and sales rose dramatically and became a major cushion for in-province power rates as the final effects of all the adverse forces were absorbed by the utility. This helped satisfy the low power rate objective. In-province rates have historically been 13 to 17% lower as a result of the benefits achieved through these interconnections.

NB Power's rate increase performance in the 1980's relative to other Canadian utilities has been very satisfactory. While power rates in New Brunswick, overall, are still above the Canadian average, major gains have been made since 1980. NB Power's financial position has also improved during the period.

The most significant relative rate gains have been made since April 1985 due to the absence of rate increases in New Brunswick. The adverse forces of the recent past have abated. Oil prices collapsed in 1986 and today appear relatively stable over the near term. Interest rates have recently dipped into single-digit figures in Canada, although volatility of rates is being experienced. The Canadian dollar has rebounded since the end of 1986. Loads have fully recovered from the 1982 recession and are growing rapidly.

It is from the vantage point of a much improved position that NB Power now assesses its future.

B. PRESENT DEVELOPMENT SETTING

The formulation of a long term generation development plan for a power utility necessitates that many parameters be forecast including; energy and demand, availability of opportunities for importing energy, availability of markets for export energy, projected costs, fuel prices, and operating costs.

The key parameters that have been used as input to NB Power's development planning are outlined in this section.

1. Load Forecast (1988)

The overall long term growth in energy supply to in-province customers is forecast to increase from 11,751 million KWh (1988/89) to 17,598 million KWh (2002/03), an overall rate of 2.7% per year. Correspondingly, the peak hourly demand related to this energy supply is forecast to grow at an average annual rate of 2.8% per annum from 2336 to 3519 MW in January 2003.

Details of this forecast are contained in NB Power's "Load Forecast 1988". Within this process, allowances have been made to account for conservation efforts. The final outcome in forecasted load, then, is that load which must be met by new electrical power resources.

2. Availability of Imported Energy:

One of the significant influencing factors in NB Power's development planning has been the availability of imported energy. NB Power has taken steps during the past 15 years to strengthen its interconnections with neighbouring utilities for the purpose of importing and exporting energy.

The largest and most important of these interconnections to date have been NB Power's tielines to Hydro-Québec.

Hydro-Québec has projected that the availability of surplus, interruptible energy will decrease as a result of marketing inroads both in Québec and the United States. Recent experience has supported this prediction. In fact, if it were not for a recent firm energy and capacity contract between New Brunswick Power and Hydro-Québec initiated in 1988, very little energy would probably be available for import from that utility. This contract ends in 1994, after which, the purchased capacity of up to 350 MW must be replaced with other sources.

3. Export Markets:

During the past several years, energy exports have contributed to lower rates for New Brunswick customers. Economy energy exports to Prince Edward Island, Nova Scotia and New England have been the most significant. The continuation and expansion of access to these markets will provide continuing benefits for NB Power's customers. Increased competition in the export markets notably from Hydro-Québec have and will continue to make it difficult to sustain previous export levels. To help alleviate this uncertainty, a strategy of commitment to long term firm sales contracts has been sought in conjunction with reinforced transmission access to the market areas.

(a) NEPOOL

New England is by far the largest potential market for electrical energy exports from New Brunswick. In 1987-88 NB Power exported some 5300 million KWh/yr of energy to New England. The penetration of Hydro-Québec into this market may reduce the quantity and related benefits from economy energy being exported.

However, in New England, utilities are presently unable to build new generation because of the utility regulatory climate and the effect of the Public Utilities Regulatory Policy Act (PURPA). Consequently they are considering alternatives such as: independent power producers, gas turbines, refurbishing of old plants, co-generation, and purchases from Canadian utilities.

Although these alternatives are not necessarily the preferred long term choices of those utilities, Public Utility Commissionrulings encourage them, since only the energy costs and "prudent" capital expenditures are passed through to the customer, whereas capital costs in excess of requirements must, in hindsight, be borne by the utility shareholders.

In view of the outlook for New England, the potential for exports from Canada in the 1990's is significant. Hydro-Québec, NB Power and Nova Scotia Power Corporation have all been pursuing export contracts with the New England utilities for the 1990's. Most notably, Hydro-Québec has signed for the supply of firm energy and power to New England utilities through the 1990's.

Nova Scotia has proposed coal-fired exports via a submarine cable link to Maine. Although a very costly alternative, the feasibility will depend on technological developments and market conditions.

NB Power continues to sell, under existing contracts, some 550 MW of power into New England including just recently signed short term capacity contracts for supply of a total of 120 MW of power for 1988/89. NB Power has been actively negotiating with the various utilities in the hope of extending some of these contracts and making new longer term sales. However, the situation seems presently to be one of "wait and see". There are questions in New England to which only time will yield the answers:

- When will Seabrook Nuclear Plant be commissioned?
- Will the load forecast be higher/lower than presently predicted?
- Will cogeneration projects be a reliable source of capacity?
- How effective will conservation be towards reducing generation needs?
- Will public opinion allow the continued operation of existing nuclear facilities in New England?
- What system problems will emerge with the addition of large Canadian interconnections?

With the combination of these uncertainties, it is difficult for New England utilities at this time to commit to Canadian purchases for the long term. Therefore, in order to be successful in the market place, NB Power must maintain a continuous presence with competitive proposals.

(b) Prince Edward Island

Since the installation of the 100 MW undersea cable in 1977 the major portion of Prince Edward Island's electricity needs have been supplied by NB Power. This has been through interruptible energy sales, firm capacity and energy sales, and their 10% ownership in the Dalhousie II plant.

In 1988 a new power sales agreement was concluded with Prince Edward Island. The contract commenced in November of 1988 and runs through October, 1994. It provides for firm capacity sales of up to 50 MW and annual energy sales of up to some 600 million KWh.

At the present time Prince Edward Island has not committed to a final means of meeting its needs beyond 1994. NB Power's objective is to continue its role as the competitive supplier of Prince Edward Island's power and energy needs.

(c) Nova Scotia

Nova Scotia has not been considered as a market for exports because of its plans to develop its own coal-fired generation using Nova Scotia coal. It is therefore assumed that there will be little opportunity for developing new electrical energy markets there.

C. GENERATION REQUIREMENTS

NB Power considers two criteria for the determination of generation reserve requirements for in-province loads and hence the timing for new generation additions to the system. The two criteria are required to correctly allow for NB Power's strong interconnections and energy-limited hydro system in maintaining a sufficiently reliable power system.

The application of these criteria to NB Power's forecasted load and resources gives a prediction of the required timing for new generation additions. A summary of results of NB Power's "Load and Resource Balance 1988" is given in Table III-1. This table includes the latest purchase contract with Hydro-Québec with its total options for capacity, an uprating of a presently capacity limited Coleson Cove unit to full capacity and a new 30 MW gas turbine being installed on the Island of Grand Manan, but it does not include any generation additions beyond 1989.

TABLE III-1

NB POWER - LOAD & RESOURCE BALANCE

Fiscal Year	Surplus/Deficit MW
1988-89	172
1989-90	157
1990-91	55
1991-92	170
1992-93	179
1993-94	104
1994-95	(275)
1995-96	(355)
1996-97	(433)
1997-98	(511)
1998-99	(588)
1999-00	(679)
2000-01	(772)
2001-02	(866)
2002-03	(959)

The table shows that new generating capacity is required by 1994 and that close to 1000 MW will be required in the next decade.

The requirement for the 450 MW unit comes as a result of growing load and cessation of the 350 MW capacity purchase from Hydro-Québec in October of 1994. In fact, an option exists to reduce the contract in the final contract year assuming the new 450 MW coal-fired plant is completed on schedule. It therefore allows flexibility in timing for the new unit enabling it to be properly commissioned with allowances for possible schedule delays.

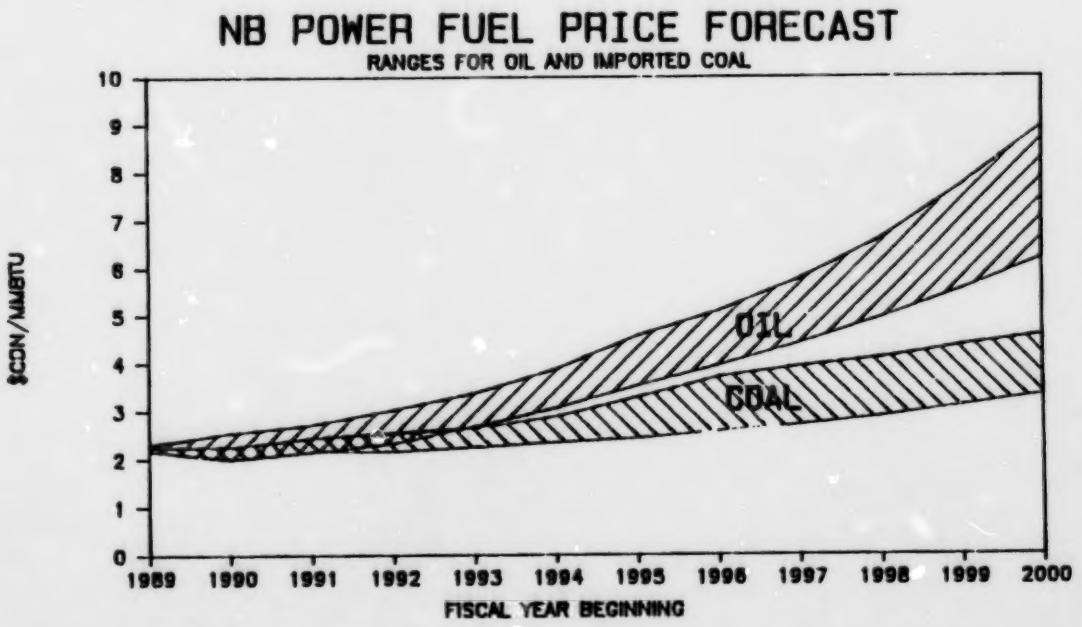
D. FUEL FORECASTS

The single most influential variable in generation planning has been the price which NB Power will pay for fuel in the future. This has been a subject of much study in recent years, especially since the collapse of oil prices in late 1985 and 1986.

NB Power's production costs are sensitive to the price of imported oil. Over 46% of the energy produced or purchased for in-province use in 1987-88 was tied to oil prices.

NB Power's present fuel forecast for coal and heavy fuel oil is shown in Figure III-1. These projections are based upon recent information received from Data Resources Incorporated and Petroleum Economics Ltd., NB Power's two fuel price forecasting consultants. Today, world coal and heavy fuel oil are very competitive because of the recent oil price collapse. As oil prices recover the historical cost advantage of coal is expected to be maintained once again.

FIGURE III-1



E. ENVIRONMENTAL CONSIDERATIONS

NB Power operates under the regulatory umbrella of the Provincial Government Department of Municipal Affairs and Environment (DMA&E) for environmental issues pertaining to its operation. The jurisdiction of this regulatory body encompasses both the construction and operation of NB Power's generating, transmission and distribution facilities as well as the operations of NB Power's mining subsidiary, NB Coal Ltd.

In keeping with the requirements provided in applicable legislation, NB Power conducts detailed Environmental Impact Assessment programs for any major construction projects during which, at the discretion of the provincial government, public meetings for review of proposed projects are held. The Environmental Impact Assessment of the proposed 450 MW unit is contained in a separate report and therefore will not be further addressed here.

DMAE issues licenses to operate generating facilities which are reviewed at regular intervals. These licenses stipulate the conditions under which the plants can generate electricity and the limits for environmental impacts such as air emissions and effluent emissions.

There are various concerns today over emissions of oxides of sulphur, nitrogen and carbon, and associated effects on local air quality, and on local and long range deposition of acidic compounds. By far, the most pressing environmental issue for NB Power at present is that of acid rain, caused by SO_2 emissions from power plants. In a move to reduce SO_2 emissions in Canada, the Federal and Provincial Governments have agreed to limit air emissions in each of the seven eastern Canadian provinces to levels based upon 1980 SO_2 emissions. The Canada - New Brunswick Sulphur Dioxide Agreement has specified a 185,000 tonne limit for the province to be attained by 1994. The amount allotted to NB Power is 130,000 tonnes.

All environmental regulations provide constraints within which NB Power's system must be planned and operated. Most regulations have an impact on the engineering and cost of each specific facility. The regulations are met within the final design of the individual project. The SO_2 constraint for 1994, while influencing individual project possibilities, is really an overall system development constraint. Because of this it has played a major role in the final selection of a development program for NB Power.

IV. DEVELOPMENT OPTIONS

The studies conducted over the past few years have involved the investigation of numerous options for the future supply and delivery of electrical energy to New Brunswick and its interconnected systems. The selection of a development program for NB Power over the next 15 years, depends, to a large part, on variables over which NB Power has little or no control such as fuel prices, interest and escalation rates, and new environmental regulations. The key to successful development is the maintenance of flexibility for future generation choices while attaining stability in power rates. To this end, the range of development options presented are discussed with regard to their ability to meet the following goals:

- Provide adequate electricity supplies to meet the projected needs of New Brunswick.
- Improve system security by reducing NB Power's dependency on imported oil.
- Be economically beneficial to NB Power customers and to the general New Brunswick society.
- Meet all environmental standards.

Development alternatives are presented under 4 main categories: A. Interconnections, B. New Generation, C. Conversions, and D. Load Management followed by discussions of E. Environmental Issues, and F. Summary of Options.

A. INTERCONNECTIONS

NB Power has developed strong interconnections with neighboring utilities both in Canada and the United States which continue to play an important role in its long term development. Benefits from both unit participation contracts and the purchase and sale of surplus energy have helped stabilize electricity costs for New Brunswick customers.

Maintaining and expanding the capability of these interconnections forms an important part of NB Power's future development.

1. Hydro-Québec

NB Power presently maintains 2 direct current and 2 radial ties with Hydro-Québec with a total effective capacity of about 1000 MW. NB Power has historically purchased hourly fuel replacement energy from Hydro-Québec at 80% of NB Power's alternative production cost.

NB Power will strive to maintain a high level of energy imports from Hydro-Québec as long as the pricing of the energy is competitive with other supply options. However, the amounts of surplus Hydro-Québec energy, which NB Power has historically purchased, has diminished and is expected to further decline. The development by Hydro-Québec of interconnections into New York and New England has created strong competition for what energy is available.

For New Brunswick, this means either reduced fuel replacement energy imports from Hydro-Québec or alternatively, the need to negotiate firm purchases of energy, with or without capacity, at higher prices.

NB Power meets on a regular basis with Hydro-Québec to review its future requirements for energy and capacity. The meetings in the summer and fall of 1987 concerning the proposed Hydro-Québec/NEPOOL Phase II power sale resulted in the development of the 1988-1994 purchase tailored to meet NB Power needs.

(a) 1988-1994 Hydro-Québec Contract

The reserve requirements for NB Power as projected in 1987 dictated a need for firm capacity by 1990. One of the most cost effective means for meeting this requirement was through power purchases from Hydro-Québec.

The Hydro-Québec - NB Power contract for firm energy, with optional capacity, signed in 1988 does just that.

The energy portion of the contract provides some 3500 million KWh of energy per year to October, 1992 and 2600 million KWh from November, 1992 to October, 1994. This energy assures NB Power a supply of energy in place of the rapidly diminishing replacement energy that was historically available from Hydro-Québec. It lowers reliance on oil generation and lowers SO_2 emissions.

The capacity portion of the contract provides for 50 MW beginning in November, 1988 and increasing to as much as 350 MW over the term of the contract. This gradually increasing capacity was negotiated to fit NB Power's projected requirements through 1994.

Included in the contract is an option to reduce the capacity portion for 1994. This provided NB Power with the opportunity to target a new generation addition for 1993 with assurance of commercial in service by 1994.

The pricing of the Hydro-Québec contract is on a formula escalated by a coal index. As such it lessens the risk to NB Power of oil price swings.

(b) Long Term Purchase

Hydro-Québec has made long term capacity and energy options available to NB Power and different New England and New York utilities. These contracts are priced to recover the costs that Hydro-Québec would incur to advance generation to meet them and are shaped to be similar to 30 year life costs for coal-fired thermal generating units. A contract that was proposed for Central Maine Power, scheduled to begin in 1992, and one with Vermont utilities including long term capacity scheduled to begin in 1990 are typical of these offers.

Long term capacity purchases from Hydro-Québec under similar terms and conditions are options that have been considered by NB Power. These contracts would adequately meet system demand requirements as they are for firm capacity with energy at 75% capacity factor scheduled weekly by the purchaser. They would also meet NB Power's off-oil goal and would not add to environmental impacts.

However, quoted costs for these contracts are higher than the projected costs for NB Power to construct its own coal-fired generating units. These contracts also would have no socio-economic benefits for New Brunswick in that there would be no construction jobs and no permanent operating jobs created. For these reasons, this option has been thus far rejected as a satisfactory solution to current NB Power needs. Nonetheless, NB Power will continue to communicate with Hydro-Québec and could consider this type of option in the future.

2. New England

New England utilities have been and will continue to be the chief export customers of NB Power. NB Power has enjoyed significant benefits from its interconnections with New England and will strive to continue these in the future.

The present capacity of the interconnection with southern New England is about 700 MW. The transmission limitations presently being imposed, along with projected system stability problems, as a result of Hydro-Québec's development of very large interconnections with New England, may dictate the need for strengthened transmission interconnections between New Brunswick and New England.

For some time, NB Power and the New England utilities have been considering the addition of a second 345 KV transmission interconnection from New Brunswick through the State of Maine. This addition would provide increased power transfer capability to southern New England markets and could provide a solution to the pending system stability problems associated with large quantities of imported energy to New England.

The first phase of this proposed transmission is for a 345 KV line from Point Lepreau in New Brunswick to just south of Bangor at Orrington in Maine. This first section would improve the stability of the interconnected

northeastern system for contingencies on the Québec system and could increase the total transfer capability from New Brunswick to New England by about 300 MW to a total of 1000 MW. Additionally, the increased transmission capacity could provide improved access to the larger southern New England market for export sales.

NB Power's export options include the continuation of participation sales from the Point Lepreau I nuclear plant. Some 130 MW of the current sales expire in 1991 while an extension of 100 MW to 1993 and 50 MW to 1994 has tentatively been agreed to. Larger continued sales would be profitable and would limit financial exposure should difficult be experienced with the unit.

NB Power also has the option of selling a portion of any new generation units to New England. The sharing of construction, operating and maintenance costs will yield benefits for NB Power's customers. Major benefits from participation sales of Lepreau or any new generation are attained when the amount of the sale is shaped to coincide with NB Power's needs and the size of the unit sold. This type of sale essentially allows for smaller increments of new generating capacity but at the economies of scale of larger units.

Proposals to combine sales from Point Lepreau and new coal units amounting to 600 MW of capacity and energy for 10-20 years have been made to New England utilities. The second 345 KV interconnection has been proposed to allow additions to the 600 MW package. While a valuable adjunct to the proposed sale, the transmission project is not a precondition in that the existing circuit is fully capable of transferring the 600 MW export.

3. Prince Edward Island

Prince Edward Island has secured supplies to meet its projected needs to 1994. Termination of its current contract with NB Power at that time will leave it deficient.

The most cost effective option that Prince Edward Island has to supply this deficit would appear to be by participation in new NB Power generation. NB Power is prepared to meet these needs. The size of the requirement to 1994 is relatively small, being less than one year of projected New Brunswick load growth. The greatest impact these sales would have on NB Power would be to alter the timing of generation required for the late 1990's by one year.

B. NEW GENERATION

NB Power's main objective in the development of new generation is to build plants which are safe, reliable and cost effective. To this end, the intention is to add the least expensive generation possible while still maintaining an acceptably reliable power system.

The key to the addition of large units on a relatively small power system is the sale of portions of these units on a unit participation basis to interconnected utilities until the power system can most economically accommodate the full unit capacity. Alternatively one could, through contracted purchases, postpone these units so that they are fully utilized when commissioned.

1. New 450 MW Coal Units

Coal-fired units in the 450 MW size range will be cost effective and compatible with the NB Power system size in the 1990's. The location of new coal-fired units will be such that they would have open water access to world-wide marine shipping for the import of fuel. Several site options are available to NB Power. These sites include locations on the Bay of Fundy and the Bay of Chaleur. The optimum location for each plant will depend upon the sequence of development options selected and other variables specific to each location.

The boilers for these units will be designed to burn a variety of coals readily available from world markets. Fuel delivery via large ocean-going colliers will help insure that the price for coal will be cost-competitive with other fuels and that reasonably secure supplies can be maintained.

Air emissions from these new plants will be controlled through the use of low sulphur coal thereby alleviating the need for expensive flue gas scrubbing equipment. Prudent design will insure that all relevant environmental regulations will be met.

2. Coal Unit For New Brunswick Coal

NB Power presently generates power using indigenous New Brunswick coal. In 1987-88, about 7% of New Brunswick's total electrical energy was produced from this resource. This same fuel, however, contributed close to 50% of NB Power's total sulphur dioxide (SO_2) air emissions because of its high sulphur content.

The rates of SO_2 emissions per million KWh of energy generated can be used to rank the various fuels. By this technique, New Brunswick coal generation sources are the highest, at four times the rate of emissions from the currently burned 2.75% oil and seven times the emission rate from 1% sulphur imported coal. Nuclear, hydro, and purchase sources produce no SO_2.

In order to meet the specified 130,000 tonne limit for SO_2 emissions by 1994, NB Power must either curtail the use of New Brunswick coal or alternatively find some acceptable and economical means of removing a large portion of the SO_2 emissions.

There are many and varied methods for SO_2 removal including; Flue gas scrubbing, new combustion technologies, (e.g. fluidized bed combustion) and pre-combustion fuel cleanup (e.g. coal washing).

The investigation of these methods has shown that scrubbers or fluidized bed combustion technologies may be the only presently available methods for SO_2 removal from New Brunswick coal. At present these technologies applied to high sulphur coals are in various development stages. Further testing at the demonstration plant at Chatham is helping to determine the viability of the circulating fluidized bed technology for future use in larger utility boilers.

New Brunswick coal is presently burned at Grand Lake and Dalhousie II. The coal utilization has totalled some 500 kilotonnes/year in recent years. On average, 350 Kilotonne of coal is shipped annually by rail from Grand Lake to the Dalhousie plant. Transportation of this coal is expensive and, when added to the high costs of mining, makes it difficult for this fuel to compete with other available fuels.

Based upon the assumption of continuing the coal mining industry in New Brunswick, NB Power considers the construction of a mine-mouth coal-burning unit at Grand Lake to be an option which could provide a solution to three ongoing concerns. It would:

- Lower the generation costs using New Brunswick coal by removing the rail transportation costs.
- Allow low sulphur, imported coal to be burned at Dalhousie II thereby alleviating the air emission loading in that sensitive airshed.
- Add a much needed generation source to the central part of the transmission grid.

The new Grand Lake No. 9 unit, considered as an option, is a 150/200 MW unit. It could be a conventional pulverized coal unit with the addition of flue gas desulphurization equipment or a fluidized bed unit.

This option was seriously considered for 1991 prior to finalization of the Hydro-Québec contract. Its size and construction time made it an attractive option for that time frame. However, uncertainties about the state of SO_2 removal technology and the economics of the Hydro-Québec contract made it prudent to defer this option. Three or four years of deferral should aid in resolving the questions surrounding SO_2 removal from high sulphur coal and enable NB Power to implement the most cost effective SO_2 removal methods for New Brunswick coal.

3. The Nuclear Alternative

NB Power continues to view nuclear power as a viable long term option for New Brunswick. The advantages of nuclear include stable power costs, indigenous fuel savings, readily managed environmental effects and high socio-economic benefits.

The principal disadvantage of nuclear for NB Power is the high capital cost and therefore the financial risk of the highly capital intensive facilities. It is this feature, together with the relatively large (635 MW) size of the smallest available units, which led to the utility's decision to sell more than one-third of the existing Lepreau unit on a full risk basis to U.S. participants.

For these same reasons, NB Power has generally viewed a second Lepreau unit (635 MW) as an alternative for domestic use only after about the year 2000. The foundation of Maritime Nuclear by Atomic Energy of Canada Ltd. (AECL) in 1983 and the subsequent efforts to initiate a Lepreau II (635 MW) unit were therefore totally oriented toward achieving an export project. New Brunswickers would not have participated in the financial risks of the project, nor would they have shared in the unit's output.

The Lepreau II (635 MW) project proved not to be marketable in the New England States under the current environment. The primary reason was the inability of utilities to take significant financial expenses to benefit consumers in a regulatory environment where risks were being increasingly transferred to shareholders. The nuclear unit itself was generally viewed as an attractive alternative.

In 1986, AECL proposed a smaller CANDU unit for consideration as an option to meet in-province requirements for New Brunswick. The first of its kind, the new 450 MW unit was designed to be less complicated, easier to construct and operate, and lower in capital cost than its larger predecessors.

NB Power views the scaled-down, redesigned CANDU-3 unit as an interesting option for this Province. However, the utility has steadfastly maintained that it cannot accept even the reduced capital cost expenses and financial risks of building a prototype CANDU-3 unit. Therefore, NB Power has taken the position that the project must be structured such that the costs and financial risks for New Brunswick are no greater than those of its coal alternatives.

Even with proper structuring of the prototype CANDU-3 project, the nuclear unit is not an alternative for the first 450 MW coal unit because the nuclear unit could not be constructed prior to 1995-1996. This makes Lepreau II a possible alternative for a subsequent coal unit.

The life-cycle economics of 450 MW nuclear and coal units are projected to be very close.

4. Hydraulic Development

The potential for further hydro development on New Brunswick's river systems is limited. NB Power's present hydro capacity of 865 MW attains an annual capacity factor of some 30%. It is used mainly for peaking capacity except during the runoff periods in the months of April through June. Hydro generation is valuable in that it lowers oil-fired dependence and SO_2 emissions, but is limited in its ability to reliably meet winter energy needs.

NB Power's latest project involving the hydro system was the increase of the Mactaquac headpond level by 3 feet. Other projects have been examined periodically but their economics have not, as yet, proven favorable compared with alternative sources.

For the sake of completeness, areas of potential hydro developments are identified to give the reader an insight into the remaining potential for hydro power projects in New Brunswick.

(a) Morrell

The Morrell site on the Saint John River just north of the junction of the Aroostook River with the Saint John has the potential for a 140 MW development with an annual capacity factor of 35% for average river flow conditions. Operation would be very similar to the existing Beechwood Plant. A significant advantage of this development is the ability of the Morrell resevoir to stage the release of the Upper Saint John River ice into the Beechwood resevoir. This ability to retain the upper river ice until the Beechwood ice cover is substantially weakened by the increasing river flows will result in the reduction of ice jam potential in the Perth-Andover area. Computerized ice modelling has demonstrated that the water levels in the town of Perth-Andover during the 1987 flood could have been 10 feet lover had the Morrell dam been in place.

This site could be developed as a separate project or has the potential to be integrated with a redevelopment of the Grand Falls Plant. As a separate project it is not suitable at this time to meet NB Power sustained capability requirements because of the limited amount of energy available in the winter peak period.

(b) Grand Falls Redevelopment

A project of interest to NB Power because of the large amount of energy associated with it is Grand Falls redevelopment. Redevelopment with no change in the headpond operating level and an added plant with an installed capacity of up to 300 MW could be developed to produce an additional average annual energy output of 558 million MWh. With a 20 foot increase in headpond level the same installed capacity could produce an average annual energy output of 655 million MWh. A large percentage of the additional energy would be generated during high river flow periods in the months of April to June. This would displace significant amounts of fossil generation and reduce SO_2 emissions but does not make much contribution to meeting winter peak load requirements especially for sustained periods.

(c) Grand Falls - Morrell Integrated Development

This integrated approach to increasing and enhancing the hydro-electric potential in the Upper Saint John River incorporates a pumped storage scheme at Grand Falls. A new power station would be build adjacent to the existing plant and would house 3 - 100 MW reversible pump-turbines. This project would include a new intake, pressure tunnel and surge tank separate from the existing facility. There is a requirement to have the Morrell dam in place in order that the impounded resevoir would provide the suction pool for the pump mode at Grand Falls.

A 320 MW peak export sale at a 30% daily capacity factor is proposed from this Integrated Development. Pumping is required to supplement the natural flows to guarantee this generation at system sale quality. On an annual basis pumping will be required only some 25% of the time to meet this level.

Using natural flows the Integrated Development would produce 868 million KWh/year from Grand Falls, and 430 million KWh/year at Morrell, for a total of 1298 million KWh/year. In order to guarantee the daily capacity factor at 30% even during low river flow conditions, some 232 million KWh/year of pumping is necessary at Grand Falls resulting in the production of the 177 million KWh/year shortfall necessary to meet the sale requirements.

Additional studies related to the integrated development are continuing to determine the impact of the raising of the Grand Falls headpond, and to review the most appropriate Morrell dam location, construction techniques and scheduling optimization, unit capacity, environmental impact scoping, marketing and system modelling, and other relevant subjects. These studies will result in determining the basis for an economic evaluation of the Integrated Development and assess its potential for economic and financial viability.

(d) Green River

Another potential project is the Green River Pumped Storage Project. The development would be located about two miles upstream of the Edmundston-owned Second Falls hydro development. It would create a 17 mile long lake and would have an annual energy generating capability of some 130,000 MWh from two 80 MW generating units.

The development, as proposed, would operate as seasonal storage. Water stored during the spring freshet would be released during the low flow, high load periods of December through March. The development would also operate year round as a daily cycle pump storage facility whereby the units would generate power for about two or more peak load hours of the day. The water released during the generation mode would be pumped back from the lower (Second Falls) reservoir during the night with lower cost, off-peak energy.

Green River development continues to be looked upon as a project for the future but the exact date will depend on relative economics as compared with other development opportunities, and on the extent of load growth actually experienced.

(e) Tidal Power

The development of tidal power in the Bay of Fundy has been studied periodically during the past two decades. A recent review of this extremely large undertaking has shown that the huge capital requirements and long construction period for the project render it unfeasible until at least after the year 2000.

The cyclical nature of its output does not fit the current demand needs of New Brunswick. It would require joint operation of the combined Northeast power systems to effectively utilize its' projected 2000 MW output.

(f) Small Hydro Development

Studies to date have identified a number of small hydro sites which have the potential to contribute to fuel displacement while keeping NB Power abreast of the technology inherent in such small scale developments.

Small scale hydro developments do not produce positive cash flows until late in their lifetime. The development of these options will be considered at such time as their economics prove more favorable.

(g) Other Options

Other potential hydraulic developments which remain of interest to NB Power are:

- The possibility of pumped storage operation at the existing Tobique Plant which would be related largely to better utilizing overall system generating capability.

- Development of new reservoirs and increasing the size of existing ones to enable increased energy production during low flow periods.

All hydro development possibilities continue to be assessed both on their ability to supply the short duration, electrical demand requirements of the power system, and on their ability to displace the oil fuel which would otherwise be required. It becomes a matter of balancing the economic and development effects against the opportunity to secure an energy source with which to further displace oil dependency.

Under today's projection of displacement energy prices, these projects are not economically viable in the near term solely for New Brunswick needs. Export participation however could make them attractive.

5. New Oil Fired Generation

New fuel oil fired generation is not considered an alternative in keeping with NB Power goal's of reducing dependence on imported oil. However, light oil fuelled gas turbines are options that could meet some specialized needs.

Gas turbine generators are available in unit sizes from as small as 10 MW up to 150 MW. The capital cost of these units is small but their fuel cost is significant. They are tailored to system peaking applications or back-up supply to increase system security. They are capable of providing continuous operation during the winter peak with no energy limitations. For annual demand requirements on peak below 20% capacity factor this type of generation can be cost effective.

An added advantage of gas turbines is their ability to be operated remotely allowing units to be placed in strategic areas of the system without the need for a resident operating staff. Coordinating this capability with transmission requirements provides options for increasing the security of supply and delivery of energy to particular areas of the system. The 30 MW unit committed for Grand Manan for 1989 is an example. It is expected to contribute to system winter peaking requirements as well as provide back-up generation to the Fundy Islands which are supplied currently by undersea cables.

6. Alternative Energy Sources

A final classification of generation sources are herein grouped as alternative energy sources. These generally encompass small independent power producers and cogeneration which utilize resources such as wind, sun, and biomass.

The number of developments of these types have been very few because of the competitive price of electricity in New Brunswick.

(a) Independent Power Producers

The advantages cited for independent power producers in the Canadian context seem to be that entrepreneurial entities are more inclined to seek out opportunities for small renewable resource projects than are large utilities. There may also be a view that the small entrepreneur can be more efficient as a power producer in operating these types of facilities. NB Power has no evidence to support these views.

Unlike the utility, the independent operator does not have an obligation to serve. The ongoing availability of reliable power from a facility owned by such an operator is uncertain, particularly in cases where the entrepreneur recoups his investment very early in the facility's life by subsidies or tax incentives. Long term development planning of the utility can also be jeopardized if proper controls are not in place to determine how much power should be purchased from independent power producers, on what schedule, and with what assurance of completion and continued, reliable operation.

NB Power accepts a responsibility to purchase power and energy from independent power producers at prices which equate to the utility's true "avoided cost". With this approach, and appropriate contractual arrangements to assure a reliable long term supply, power consumers in the Province can be indifferent to the selected source of generation is selected.

As a utility, NB Power encourages independent power producers to maximize the use of co-generation (ie. the concurrent use of steam for electricity generation and an industrial or direct heating application). This approach is more efficient and markedly improves the economic viability of small scale thermal generating facilities.

(b) Wind and Solar

Research and demonstration projects utilizing both wind generation and solar heating have been carried out by NB Power and others in the past to examine the potential for these types of energy sources. However, to date, large scale developments of this type have proved to be neither feasible nor economical in New Brunswick.

(c) Biomass

The potential for the utilization of biomass for the production of electricity has been a subject of interest to NB Power in recent years. However, the high transportation costs and low heating value for this type of fuel has precluded its inclusion in new generation plans. Renewed interest on the part of the Provincial Government and local wood marketing boards has initiated further studies investigating the use of wood wastes for the generation of electricity. These studies have shown that both capital and operating costs of wood-fired plants are not competitive with larger coal-fired units even when used in a more efficient cogeneration mode for the production of both heat and electricity.

Developments of this type should be initiated by the private sector which could receive payment for the energy produced based upon avoided cost methods. Through this approach, NB Power's customers will not be exposed to the higher energy costs from these generation sources allowing NB Power to fulfill its mandate of supplying competitive electrical energy. NB Power recognizes that certain renevable resource projects, such as a proposed wood-fired plant for

the Sussex area, offer the prospect of silvicultural and socio-economic benefits in addition to electricity supplies. The utility is prepared to work closely with government departments to make such projects possible while attempting to avoid some of the negative experiences which have resulted in other jurisdictions. NB Power's management believe that the price to be paid by the utility and its customers for the power and energy of such projects should be no greater than the utility's true "avoided cost".

Further studies will continue to examine the viability of these generation projects. NB Power, at its Chatham Generating Station, is proceeding to test-burn wood in conjunction with research using the fluidized bed boiler. Based upon the results of those tests and the future costs of biomass, further developments of this type could be considered.

C. CONVERSIONS

NB Power's exposure to the pricing swings of imported oil has caused concern over the past decade. Although the collapse of oil prices in the world market in 1985-86 has given at least temporary relief to this problem, the recent recovery coupled with longer term projections indicate that the price could return to previous levels within the next decade. The fact of the matter is that no one really knows what is in store for oil prices as they are so closely tied to political and economic policies in the Middle East, an area which has had a long history of unrest.

NB Power operates 1367 MW of oil-fired generation. This constitutes in excess of 40% of its total generating capacity and about two thirds of the presently available thermal generating capacity. This imbalance causes an inordinately high exposure to oil price swings, a situation which is not conducive to achieving stable electric power rates. Consequently, considerable effort has been focused on possibilities for converting oil-fired plant to alternative fuels. These plants are:

1. Dalhousie I unit - 1 X 100 MW unit
2. Coleson Cove Plant - 3 X 335 MW units
3. Courtenay Bay Plant - 2 X 100 MW, 1 X 50 MW and 1 x 13 MW units

1. Dalhousie I

The 100 MW Dalhousie I plant has been selected as a demonstration unit for Orimulsion. This unit is presently burning this emulsified bitumen on a trial basis. The success of the proposed tests will help determine the viability of the fuel as a long-term source for the Dalhousie I boiler. Alternatively, the Dalhousie I boiler, originally built to burn oil but sized for a possible future conversion to coal, could be converted to burn coal. However, cost analyses on converting existing oil-fired plants to burn coal show that Coleson Cove would be the more economically competitive choice.

2. Coleson Cove Station

(a) Coal Conversion

The Coleson Cove Conversion studies were initiated in 1981 in response to federal initiatives introduced in the 1980 National Energy Program. The originally considered project would involve the full capacity conversion of one or more of the three 335 MW units to coal-firing. Coal delivery by marine transportation to a new dock located in Musquash Harbour adjacent to the plant would allow access to world coal sources thereby enabling a secure and stable fuel supply. The construction of the dock could also provide for fuel deliveries to possible future additional generation at the site.

A unit-by-unit sequencing of conversion has been examined. The timing would depend on forecast fuel price spread between coal and oil along with future requirements for new capacity. Originally, a partial capacity conversion was considered; however, detailed study in conjunction with a Danish consulting firm showed that a full capacity conversion is technically, operationally, and economically more desirable.

Such conversion would require essentially new boilers and associated equipment. Upon completion of conversion, the units would be capable of burning a wide range of imported coal while retaining the ability to use oil if supply problems were encountered in the future.

(b) Orimulsion Conversion

NB Power has, during the past three years, been investigating another option for fuel conversion as part of its on-going research for fuel alternatives. In conjunction with NB Power, the Venezuelan company Intevep has been investigating the feasibility of using Orimulsion, a water-emulsified bitumen, as fuel for utility boilers.

As stated earlier NB Power and Intevep are presently using the 100 MW Dalhousie I unit to test burn Orimulsion. Intevep has indicated that this fuel will be priced competitively with coal and would have the further advantage of not requiring the extensive conversion costs associated with coal. The fuel does have the disadvantage of containing 3.5 to 4% sulphur and therefore will require flue gas desulphurization equipment. But with FGD equipment installed and with fuel at coal prices, this option becomes a potential least cost means of reducing SO_2 emissions from certain oil-fired sources.

Based upon the results of the test burn and the overall economics of this fuel compared with oil and coal, the conversion of at least one unit at Coleson Cove is the preferred generation conversion option and has a place in NB Power's SO_2 reduction plans.

3. Courtenay Bay Plant

The Courtenay Bay Plant is adjacent to the industrial park in East Saint John and has been considered for various types of fuel conversions. However, the age of this plant, and its location close to the heart of Saint John, limit opportunities for converting to other fuels. Space constraints and local air quality concerns are the major drawbacks. In addition, the plant sees limited usage as it is operated mainly to meet winter peak loads. Right now it is not economical, but a major conversion program remains a future option. For example, if natural gas were to become available in this area, it would provide an ideal fuel for this plant and reduce environmental emissions. In the interim lower sulphur fuel oil may become an option.

D. LOAD MANAGEMENT

In recent years, many utilities across North America have implemented or are considering measures to manage peak load. Key measures for peak load management include:

- Incentives for load curtailment at the time of utility peak
- Time of use rates
- Remote control of electric water heaters
- Public information programs to reduce power requirements at peak periods

Time-of-day load management has the effect of shifting demand and energy consumption from one period of the day to another. Because NB Power has a unique generation mix involving a high level of hydro peaking capacity, such shifts are of relatively little value. For this reason, and because of the high cost of the new metering and load control devices which are required, time-of-day load management programs have not been undertaken. This situation is not likely to change in the near term.

Conversely, interruptible sales to industry and over the interconnections do offer increasing advantages to NB Power. NB Power does not have to supply peaking capacity and associated reserves to meet these types of sales since they may be curtailed for relatively long periods on short notice. A dialogue with industry has shown a potential for load management through rate incentives for curtailing load during NB Power peaks. These types of interruptible sales are not considered feasible for residential or commercial customer groups.

The amount of this type of curtailable load management that NB Power could utilize is limited by the nature of NB Power's limited energy peaking hydro capacity. Studies done to date indicate that a maximum of 100 MW could be employed. Assuming that this full amount could be supplied by New Brunswick industry, its maximum impact would be to alter the timing of generation needs for the late 1990's by one year.

E. ENVIRONMENTAL ISSUES

The New Brunswick Government and the Federal Government have established standards and regulations governing the construction and operation of thermal power plants. The main areas concerned are for air and effluent emissions.

As discussed in Section III.E, all of these regulations except the 130,000 tonne SO_2 limit are met by proper engineering design of various projects. But SO_2 constraint of 130,000 tonnes by 1994 is a total system constraint that influences the choice of development options.

SO_2 emissions today are divided relatively evenly between New Brunswick coal-fired units and oil-fired units. Regardless of the system development options implemented this will remain true for 1994 unless specific measures to reduce emissions from these sources are undertaken. The document "NB Power Sulphur Emission Control Program 1989-2000" outlines a detailed plan with alternatives that will enable NB Power to meet the required limits.

This program is based on the three guiding factors outlined below:

- There is a need to establish a satisfactory means of reducing SO_2 emissions from burning New Brunswick coal. The optimum technology to be used, and the costs to be incurred are not yet finalized but the need is for 1994.

- Oil-fired generation is the next source that should be considered for SO_2 removal. This could be accomplished through use of low sulphur oils, flue gas desulphurization or lowered utilization.

- New generation sources can be planned with low sulphur fuels so as to have minimal impact on total emissions.

NB Power will continue to make the provincial government aware of the implications and costs for SO_2 removal. Furthermore, NB Power will, within its mandate and the regulations established, strive to meet all environmental objectives.

F. SUMMARY OF OPTIONS

The major options presented in previous sections of this chapter are compared in Table IV-1. The data presented provides a comparison of project ratings, life cycle levelized energy costs, and direct employment projections for construction and operation of each potential option.

By dividing the cost figures in Table IV-1 by the relevant employment numbers, the cost per job of each of the generation options may be determined.

TABLE IV -1

SUMMARY OF GENERATION OPTIONS

Project	Capacity (MW)	In Service Cost (1988 $M)	Project Life (Years)	Capacity Factor (%)	Levelized Cost Starting 1988 (¢/KWh)	Employment Construction (person-yr.)	Employment Operation (# Jobs)
450 MW Coal Unit	450	$640M	30	80%	6¢	2690	135
Point Lepreau Unit 2	450	$1050M	30	80%	6¢	6200	300
Long Term HQ Purchase	--	--	20	75%	7¢	0	0
Grand Falls/ Morrell Hydro	440	$670M	80	28%	8¢	7560	10
Grand Lake Coal Unit with FGD	200	$440M	30	80%	9¢	2340	112
Gas Turbine	30	$18M	25	80%	9¢	13	1
Wood Plant	25	$61M	20	80%	10¢	292	27

V. GENERATION DEVELOPMENT PLAN

After study of the options available for development, NB Power has laid out a development plan which maintains flexibility for future generation choices while attaining stability in power rates. This development plan has resulted both from a need to meet additional generation requirements for in-province loads as well as optimize the system fuel mix. This plan represents a development which NB Power could pursue within its own means for its New Brunswick customers and meet all existing environmental constraints. In addition, flexibility is built into this plan with regard to changing conditions that might arise because of technology constraints, SO_2 reduction requirements and export sale opportunities.

The program consists of the following:

- Conversion of a unit at Coleson Cove to burn Orimulsion coupled with the installation of flue gas desulphurization equipment on that unit. Environmental and engineering work have been initiated with the objective of a 1991 in service date.
- Installation of a 450 MW coal fired unit in 1993 using low sulphur coal.
- Installation of a 150/200 MW coal fired unit at Grand Lake with SO_2 removal capabilities in 1994.
- Dalhousie #2 unit fuelling changed from indigenous New Brunswick coal to low sulphur imported coal in 1994.
- An additional generation source is projected for 1997 or 1998. This could be a second 450 MW coal fired unit or a nuclear unit depending on the relative economics of alternatives and their required in-service dates.
- New Brunswick coal production maintained at a maximum of 500,000 tonnes/year.
- Annual export sales of 4000 Gwh in 1994 increasing to 5000 Gwh by 2000.

A major component of this plan involving a new fuel technology, is the conversion of a unit at Coleson Cove to burn Orimulsion. This element of the plan could provide significant reduction in SO_2 emissions. Implementation of the conversion is contingent upon acceptable test burn results at Dalhousie, satisfactory contractual arrangements with the fuel supplier and the achievement of feasible and economic fuel transfer arrangements to the plant. Test burning results to date are encouraging and negotiations are proceeding

on both fuel supply and delivery arrangements. If the conversion of a unit at Coleson Cove to burn Orimulsion is found to be unachievable, several alternative methods of reducing SO_2 emissions are available. These alternatives are presented in detail in the report titled "NB Power Sulphur Dioxide Emission Control Program 1989-2000".

The export market, must continue to form part of NB Power's development strategy. The plan outlined above includes a projection of reasonably expected levels of interruptible economy sales but no additional new participation sales other than those currently committed from Point Lepreau. However it is flexible enough to provide all the projected needs of Prince Edward Island should they choose to extend their current practice of purchasing from New Brunswick beyond their current commitments through 1994.

The sale of both a portion of Point Lepreau I nuclear capacity along with participation sales from the new coal-fired units would present opportunities for savings in generation costs and attendant benefits in system reliability and risk sharing. Should NB Power be successful in its marketing efforts for the proposed 600 MW firm capacity and energy sale to New England, some generation would be advanced. The development plan has been designed to be able to supply these needs by advancing another 450 MW unit to as early as 1994. This would provide additional construction savings by being able to construct two identical units, one immediately following the other. The remainder of the plan would remain the same aside from the possible construction of a second 345 KV interconnection with New England.